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EPIDEMIOLOGICAL USES OF AN OCCUPATIONAL HEALTH INFORMATION SYSTEM

E. K. E. GUNDERSON

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SUMMARY

The Navy Occupational Health Information Management System (NOHIMS) was designed to carry out provisions of the Occupational Safety and Health Act of 1970 and Department of Defense directives in order to help insure a safe and healthful work environment for Navy industrial workers. A prototype system is currently being tested at two large naval industrial facilities.

The primary functions of NOHIMS are to identify workers exposed to environmental hazards; schedule exposed workers for periodic examinations; provide exposure histories and recommended tests; store and manage personnel, medical, and environmental data; generate management reports, and compile standardized data for epidemiologic analyses.

NOHIMS consists of two subsystems, an Occupational Health Component and a Medical Component, which can operate separately or as one system. Three types of data are required: personnel data, environmental data (industrial hygiene surveys), and medical data. The raw data are evaluated by means of reference tables which point to appropriate actions. NOHIMS then generates pertinent reports for principal users of the system.

NOHIMS uses the MUMPS language which affords great flexibility, user friendliness, and extensive cross-referencing of data elements. These special features of NOHIMS make it a powerful tool for epidemiologic analysis, a assessment of risk factors, and detection of disease.

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EPIDEMIOLOGICAL USES OF AN OCCUPATIONAL HEALTH INFORMATION SYSTEM

INTRODUCTION

The U.S. Navy has hundreds of thousands of workers (both civilian and military) involved in a great variety of industrial operations and exposed to many hazardous agents. To help provide a safe and healthful work environment for these workers as required by the Occupational Safety and Health Act of 1970 and Department of Defense directives, Naval Health Research Center has developed the Navy Occupational Health Information Management System (NOHIMS). A prototype system is currently being tested at two large naval industrial facilities, an aircraft repair facility in San Diego, California, and a shipyard in Bremerton, Washington. The purpose of this paper is to describe NOHIMS as a functional system and to indicate some of its possible uses for epidemiological research.

FUNCTIONS OF NOHIMS

The primary functions performed by NOHIMS include: identifying individuals exposed to work place hazards; scheduling exposed workers for periodic examinations; providing medical personnel with exposure histories and a list of recommended tests and procedures; storing and retrieving medical and environmental data; generating management reports; and compiling standardized information for epidemiologic analyses. For these functions to be performed, data are required from the personnel department, from industrial hygienists and safety specialists, from the medical department, and from workplace supervisors. The raw data are placed in proper context by using reference tables compiled from authoritative sources to prepare reports and recommendations for physicians, industrial hygienists, safety specialists, and management.

COMPONENTS OF NOHIMS

NOHIMS consists of two principal subsystems, an Occupational Health Information Component and a Medical Information Component, which can operate as separate, stand-alone systems or can be merged into a unified system. The Occupational component, was created or written specifically for NOHIMS and contains six primary modules: (1) Agency Data; (2) Personnel Data; (3) Environment Data; (4) Survey Data; (5) Hazard Data, and (6) Maintenance Functions. The options for the first five modules can be used by anyone in the occupational health program; the Maintenance Functions are used only by the System Manager. A brief description of these modules will illustrate the capabilities of the system. The Agency Data module contains information

about the organizational structure of the industrial facility, including the number and names of all organizational levels and entities.

For example, a small facility might contain only two organizational levels, department and division. Within each of these levels there could be any number of units or work groups. The module contains the names and codes of all units at all levels of the organization. This module does not provide information as to physical location or environment. Such information is contained in the Environment Data Module.

The Survey Data Module handles all information about work environments collected by industrial hygienists, including specific chemicals or agents present, methods of measurement, concentrations, usage rates, and protective equipment.

The Hazard Data Module manages entry, storage, and retrieval of information about potentially hazardous substances that are used at the facility, including Threshold Limit Values, exposure limits and action levels, agent synonyms, medical monitoring requirements for each agent, Chemical Abstract Service number, and agent classification.

The Medical Component of NOHIMS is an existing software package called COSTAR (Computer Stored Ambulatory Record). The COSTAR system was originally developed at Massachusetts General Hospital, Boston, in the 1970s and is now the most widely used computer package for medical applications in the United States. The programming language for COSTAR and NOHIMS is the ANSI X11.1 MUMPS which is highly interactive, greatly facilitates information retrieval and manipulation, and has high computer host independence. MUMPS recently was adopted for implementation of the Veterans Administration medical recordkeeping system, and COSTAR is currently being tested at several military medical facilities by the Tri-Service Medical Information System Office of the Department of Defense.

OVERVIEW OF NOHIMS FUNCTIONING

The flow of information into and through NOHIMS from the collection of raw data to the interpretation and reporting of results can be summarized as follows. Three types of raw data are fed into the computer--personnel data (worker identification, location, occupational history and demographic information); environmental data (workplace environment, survey data, and hazard identification); and medical data (medical histories, physical examinations, and laboratory tests). The raw data are evaluated in terms of a set of reference tables which give the information meaning

and aid in recommending appropriate action. These reference tables include a table of job titles, a Threshold Limit Value (TLV) table, a table specifying the required medical surveillance for a particular exposure, and tables giving normal and abnormal ranges for various laboratory test results.

The next stage of information processing involves the generation of pertinent reports. NOHIMS currently provides seven reports. The Industrial Hygiene Survey Report is generated from both personnel data and environmental data with input also from the TLV and job titles tables. The principal users of this report are the industrial hygienist, the safety specialist, and the work center supervisor.

When workers have been exposed to a hazardous or harmful substance, NOHIMS generates a report that notifies the occupational health physician of the Individual Exposures. The third report, the Patient Data Sheet, is a summary generated from the patient's medical history, most recent medical data, and exposure data, with additional input from the job titles table of required medical surveillance, and the range of normal limits for lab test results. This report is prepared for the occupational health physician before each scheduled patient visit but may also be requested on demand for walk-in or emergency visits. It provides a list of clinical examinations and laboratory tests that should be performed on that individual. The occupational health physician, after examining a patient, provides a Medical Certification report that indicates whether the worker is fit or unfit to perform his or her job. This certification is sent to the work center supervisor. The fifth report prepared by NOHIMS, a Monthly Compliance Report, utilizes personnel data and medical encounter data to monitor compliance with the required medical surveillance program. Finally, NOHIMS provides the Medical Services and Outpatient Morbidity Report and the Report of Occupational Health Services. Information from this document is used to prepare a Semi-annual summary of clinical services required by higher levels of Navy management. The capability exists to generate additional reports or modify existing ones to suit users' needs, and, of course, any hazard, survey, personnel, or medical data can be retrieved instantly when needed. A general query program and report generator are under development for future epidemiological and management use.

SPECIAL FEATURES OF NOHIMS

The MUMPS language affords some important capabilities that are critical to the great flexibility of NOHIMS design. NOHIMS offers users the opportunity to interact with the information system at various levels of specificity by making choices from

hierarchical option menus. One of the most critical problems in any occupational health information system is tracking individuals through their exposure experiences in order to build as accurate and complete an exposure history as possible. Such exposure histories are needed in the individual case to infer possible etiology as a basis for treatment and at the aggregate or group level to support epidemiologic investigations of suspected health hazards. The extensive cross-referencing feature of NOHIMS is one of the major characteristics of the system that assures maximum flexibility and adaptability. The NOHIMS file structure provides pointers from one type of data element to another so that it is possible to track workers by social security number through their entire work history and medical encounters. If concentrations or levels of harmful physical and chemical agents are sampled periodically in specified work locations, cohorts with relatively homogeneous exposure experiences can be defined for intensive study. The great flexibility inherent in the design of NOHIMS and its extensive cross-referencing capability give NOHIMS unique utility for epidemiologic investigations.

EPIDEMIOLOGIC USES OF NOHIMS

The number of epidemiologic questions that might be addressed to NOHIMS is very large. The following set of questions offer some examples:

- (1) What is the population-at-risk that is potentially exposed to a particular hazardous agent?
- (2) Of those workers exposed, in what work environment were they exposed, at what levels of exposure, at what time and for how long?
- (3) What are the medical effects of this exposure and what organ systems or body parts are affected?
- (4) Among those workers exposed, who received required physical examinations and was appropriate personal protective equipment provided?
- (5) Do the exposed workers have common risk factors that are not present in the rest of the population at risk?

A new and useful concept, the Sentinel Health Event (SHE) has recently been introduced into the occupational health literature (Rutstein, et al., 1983). The SHE is a disease, disability, or untimely death which is occupationally related and whose occurrence may (1) provide the impetus for epidemiologic or industrial hygiene studies, or (2) serve as a warning signal that materials substitution, engineering

control, personal protection, or medical care may be required. The current SHE list includes about 50 disease conditions.

A current Navy study provides an example of a epidemiologic approach to one of the 50 listed SHEs, agranulocytosis or neutropenia (Garland, et al 1984). In this study we are using total white blood cell (WBC) count as a measure of neutropenia.

This serves as a good example of physiologic monitoring to prevent more serious disease for several reasons: (1) it is an acute effect; (2) it occurs before manifest serious disease, and (3) an intervention may prevent a more serious disease.

Table 1 lists the condition and possible etiologic agents that are currently documented.

NOHIMS would utilize this information in two major ways: (1) Use of the Medical Component to identify persons with neutropenia and the Occupational Component for possible etiologic exposures, or (2) use of the Occupational Component to identify persons with exposures that may place them at risk for neutropenia and initiation of hematologic surveillance for this condition. In this example, NOHIMS would allow for the successful control of an occupationally related disorder that could predispose to more serious disease by linking two crucial concepts: (1) rapid and complete case identification, and (2) accurate exposure measurements. It can be seen from this and the previous examples that NOHIMS indeed offers promise as a powerful epidemiologic tool.

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disease and to assess occupational and environmental health risks. An example of the utilization of NOHIMS as a powerful epidemiologic tool is presented and discussed.

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